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Investigating the Causes of Non-realization of Project Prediction and Proposal of a New Prediction Framework

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Abstract

The main goal of the paper is to identify the causes of non-realization of project prediction and to propose a new framework for project prediction. A secondary goal is to explain why the approaches to project prediction used currently do not provide satisfactory results. The research was realised in the form of qualitative research using semi-structured interviews. The findings reveal that the main causes of non-realization of project prediction are follows: there is no methodology that could be practically used; simplified approaches to project prediction usually have low reliability for which reason they are generally unusable; suitable input data and information for project prediction are not available. The main contribution made by the paper is the identification of causes of non-realization of project prediction and the proposal of a new framework for project prediction that respects changing conditions during the lifecycle of the project and changes in the way of thinking in project prediction. A prerequisite for its application is a functioning system of knowledge management in projects, including the realization of post-project analysis.

Keywords

Project management; Knowledge management; Project prediction; Finite automata; Markov chains.

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1 Introduction

Given the current turbulent environment and the increasing complexity of implemented projects, often in an international environment, it is necessary not only to evaluate the status of a project at a given date, but first and foremost to determine the expected further development of the project – i.e. project prediction. Project prediction is a procedure used to create a prediction or estimates of the future development of the project. Project managers typically analyse metrics such as duration, cost and quality to identify whether a project will be delivered as planned (Rabechini et al., 2022; The Indeed Editorial Team, 2023).

Without a sophisticated prediction of the development of a project, it is not possible to apply any measures in time that would minimize negative deviations (time, cost, quality) from the project plan. Moreover, reacting only to the current status of the project usually comes too late. This is confirmed not only by everyday project practice (Tina, 2021), but also by the theoretical fact that a project must be viewed as a dynamic system in which implemented actions will manifest themselves only at a certain distance (Bobalova & Novotna, 2021; Skalický et al., 2017).

The need to predict the development of a project has already been repeatedly pointed out at a number of international conferences dealing with the issue of project management. At the same time, the rules contained in the latest version of PM BOK (Ng et al., 2020; Project Management Institute, 2021) and ICB (IPMA, 2015; Vukomanovic et al., 2016) require that not only is the current status of the project presented in project reporting, but also that the prediction of the further development of the project is presented.

However, the reality remains that project managers are not used to the requirement of project prediction implementation and, first and foremost, do not have any adequate method or, at the very least, a framework for how to implement project development prediction in practice – if we disregard expert estimation and "prediction" in the context of the EVM (Earned Value Management) method. Project prediction is currently implemented mainly intuitively. It is a relatively simple, fast and cheap method. However, Dan Ariely points out that this approach to forecasting can be highly flawed (Ariely, 2011). Conducting project prediction in this way is insufficient, particularly in the current VUCA (Volatile, Uncertain, Complex, Ambiguous) environment (Fassinger et al., 2017).

The main goal of this paper is to identify the causes of non-realization of project prediction and to propose a new framework for project prediction. A secondary goal is to explain why the approaches to project prediction currently used do not provide satisfactory results.

2 Literature review

2.1 Methodology of literature review

Literary research of the topic project prediction focused on articles or previous papers on analysis published in the renowned scientific databases Web of Science and Scopus. These science databases are generally accepted for their scientific value. The authors searched for available scientific papers according to title, abstract and keywords such as "project prediction", "project forecasting", "project progress" and "project development".

2.2 Review of relevant literature

Prediction of the development of project time and costs based on the principle of the EVM method (APM, 2024; Vanhoucke, 2014) is presented in the research by the authors Naeni et al (2014). They apply fuzzy modelling to the time and cost indices of the EVM method, which makes it possible to better respect the uncertainty associated with the life phases of the project (Naeni et al., 2014). The research by Kim and Pinto focused on predicting the development of project costs. Historical CPI (Cost Performance Index) data in the context of the EVM method is used as input data for predicting project costs by calculating the probability of the indicator EAC (Estimation at Completion). They denote the proposed model as EAC (P-EAC). They also proposed a simulation for the graphical representation of other probable trajectories of the development of the indicator CPI (Kim & Pinto, 2019). The research by the authors De Andrade et al. focused on increasing the accuracy of project duration prediction by extending the EVM method to EDM (Earned Duration Management). Empirical research in the field of construction has shown that the accuracy of project duration prediction can be increased in this way and that the EDM indicator is more reliable (de Andrade et al., 2019). The research by Abdel Azeem et al. aimed to compare three methods of project duration prediction. These were two deterministic methods – EV (Earned Value in the context of the EVM method) and ES (Earned Schedule – derived to EVM) – and one stochastic method – KFFM (Kalman Filter Forecasting Model). The accuracy was evaluated on the basis of the indicator average percentage of error in the form of a case study. The results show that KFFM performed better as compared to the EV and ES prediction models (Abdel Azeem et al., 2014). The principle of the Kalman filter as a suitable method for project prediction is also confirmed by the research of the authors Kim et al. They also verified the sensitivity of prediction methods in the context of EVMs and their S-curves. The results show that the approach using the Kalman filter is sufficiently robust and best takes into account the nonlinearity of the project progress curve (Kim & Kim, 2014).

Project prediction based on S-curves is also the basis for the research by Lin et al. The authors present a combination of the grey dynamic model and the residual modified model for predicting project development in the field of construction. The indicators MAPE (Mean Absolute Percentage Error) and SDY (Standard Deviation of Y) were used to verify accuracy (Lin et al., 2012).

The application of the principle of knowledge management in project management with the aim of its prediction is also a general framework for the research by the authors Sanchez et al. Their research uses data from past projects (from the oil and gas industry) to identify knowledge and a Bayesian network to formalize knowledge from project management experts (Sanchez et al., 2020). The principle of applying predictive association rules for knowledge discovery in the field of software project management is addressed by the research by the authors Garcia et al. (2004). A model using the BBN principle (Bayesian Belief Networks) was the subject of research by Rodriguez et al. In their research, they compared a dynamic model using the BBN principle with a static model in the context of the COCOMO (Constructive Cost Estimation Model) and Akiyama models (Rodriguez et al., 2002). Research by Gardoni et al. developed a methodology for predicting the evolution of project duration based on an adaptive Bayesian method. This methodology is based on working with past recorded data and information on project development (Gardoni et al., 2007). A data mining method was also applied by the authors Tu and Fu for the construction of a decision tree for predicting the development of projects (Tu & Fu, 2010). The use of information and knowledge from past projects with the aim of increasing the management performance of current and future projects is the topic of research by the author Kaushik. This research identified warning signs of negative project development and their relationship to future project performance. This relationship was identified using dynamic analysis of information generated from past projects. The research results show that there is some potential for the use of key information from past projects to improve the performance of current and future projects (Kaushik, 2013). Project prediction based on project risk prediction is the subject of research by Filippetto et al. The authors propose a computational model to reduce the probability of project failure using risk prediction. The proposed model makes it possible to identify and monitor project risk during the project lifecycle. Their approach is based on the analysis of past project information to derive potential risks for new projects based on their similarity (Filippetto et al., 2021). The authors Chen et al. use a complex process-oriented dynamic model for the prediction of personnel resources and evaluation of project costs and revenues. They applied the model to 41 real IT projects. Their model was verified, with its prediction accuracy amounting to an average of

90%. The existence of the model provides project managers with a tool that can be used not only for prediction, but also for the simulation of key project processes (Chen et al., 2008).

2.3 Summary of literature review

The results of the literature review show that approaches to project prediction are based on two determinants:

1) Project prediction based on the principle of the EVM method with various modifications. This approach is directly related to the evaluation of project status as a starting point for its prediction.
2) Project prediction based on the principle of KM (Knowledge Management). This approach is based on the assumption that data and information about past projects are available and used as basic inputs for project prediction. Prediction is based on various methodologies such as dynamic modelling, stochastic modelling (e.g. Bayesian network) and data mining techniques.

3 Research methods

3.1 Research design

The research methodology is based on the fundamental principles of system methodology as an intersection of system approach, system thinking, system disciplines and system algorithms (Janicek, 2017). The fundamental research phases in the context of system methodology: problem situation definition – motivation, problem formulation, goal definition (see Introduction); research study (see Literature Review); method selection (see Methodology); presentation of results (see Results); results analysis (see Discussion).

Qualitative research in the form of a controlled semi-structured interview was applied with regard to the defined problem situation and the established research goal. The methods of categorization, abstraction and content analysis were used in the phase of literature research.

The method of Pareto analysis was applied in the phase of analysis of empirical data for identification of significant causes of non-realization of project prediction. The method of induction was used in the phase of the interpretation of research results.

Two research questions were defined for identification of causes of non-realization of project prediction and to identify the reasons why the current approaches to project prediction do not provide satisfactory results (see the first part of the main goal of the article):

1) What are the causes of non-realization of project prediction?
2) Why project prediction approaches currently used do not provide satisfactory results?

The newly designed framework of project prediction (see the second part of the main goal of the article) takes into account the identified causes of non-realization of project prediction and minimizes the weakness of current approaches to project prediction.

3.2 Data collection

Input data was obtained using a controlled semi-structured interview. This is a suitable technique for the collection of input data with respect to the main objective of the paper. Interviews took the form of targeted personal meetings with respondents during the course of 2023. The average interview time was around 30 minutes.

The respondents were participants in project management courses of companies from the Czech Republic. The respondents were usually experts in the field of project management, since they have worked in companies in the positions of project team leaders or project members. The respondents also included the authors´ colleagues (academic staff) focusing on the area of project management abroad (Poland, Slovakia, Spain, India) who were visited by the authors thanks to the university staff mobility programme (particularly Erasmus+) or as participants in international conferences, e.g. HED (*Hradec Economic Days – Project Management*, 2024). The sample takes in 119 respondents. The respondents represented a range of organizations from the perspective of both size and economic activities.

- Size – number of employees: micro enterprises (fewer than 10 employees), small enterprises (10 to 49 employees), medium-sized enterprises (50 to 249 employees), large enterprises (250 or more employees) (OECD, 2023).
- Economic activities – ISIC Code (The International Standard Industrial Classification of All Economic Activities) – broad structure – 21 sections (Vereinte Nationen, 2008).

Table 1 presents the distribution in terms of company size and type of economic activities. The largest number of respondents represent medium-sized and large companies engaged in business in manufacturing, construction, information and communication (see Table 1).

Table 1. *The structure of the sample.*

ISIC Code/Enterprise size	**Micro**	**Small**	**Medium-sized**	**Large**	**Sum**
Agriculture, forestry and fishing			2		2
Mining and quarrying					0
Manufacturing			16	4	20
Electricity, gas, steam and air conditioning supply				1	1
Water supply; sewerage, waste management and remediation			2		2
Construction		3	26	21	50
Wholesale and retail trade; repair of motor vehicles and motorcycles					0
Transportation and storage		1	3		4
Accommodation and food service activities					0
Information and communication			15	4	19
Financial and insurance activities				8	8
Real estate activities			1		1
Professional, scientific and technical activities					0
Administrative and support service activities				2	2
Public administration and defence; compulsory social security				3	3
Education				4	4
Human health and social work activities			2		2
Arts, entertainment and recreation			1		1
Other service activities					0
Activities of households as employers; undifferentiated goods- and services- producing activities of households for own use					0
Activities of extraterritorial organizations and bodies					0
Sum	**0**	**4**	**68**	**47**	**119**

4 Solutions and Results

A set of causes of non-realization of project prediction has been derived from the empirical research (see Table 1 – column 2). These causes were further analysed with the aim of identifying the most significant ones.

4.1 Identification of significant causes of project prediction non-realization

Pareto analysis was used for the separation of significant causes of non-realization of project prediction from less significant ones.

The significant causes of non-realization of project prediction and their serial number are given in the Table 2 – column 2 and 1. The absolute frequency (see Table 2 – column 3) represents the number of respondents who ranked a given cause of non-realization of projection prediction as significant. The relative frequency (see Table 2 – column 4) represents how often a given cause of non-realization of project forecasting occurs relative to the total number. The main advantage of relative frequency is its independence of the total number of observations. The cumulative frequency was calculated (see Table 2 – column 5) to identify the Pareto rule boundary (80/20). This is calculated in this case from the relative abundance values by successively adding these values in descending order.

Table 2. *The results of Pareto analysis.*

No.	Causes of Non-realization of Project Prediction	Absolute Frequency	Relative Frequency	Cumulative Frequency
8	There is no practical methodology that would serve as a starting point for project prediction.	98	17.41%	17.41%
4	The results from simplified ad hoc project predictions are usually of little relevance to project management and are therefore generally unusable.	91	16.16%	33.57%
1	There is no knowledge of how actually to make a project prediction. Many methodological documents such as the IPMA Competence Baseline and PMBOK do not explicitly contain information on project prediction.	89	15.81%	49.38%
3	The suitable input data, information and knowledge are not available for project prediction (e.g. from the evaluation of post-project phases of past projects).	80	14.21%	63.59%
2	Project prediction is considered unnecessary because the interviewers believe that it cannot be practically implemented in a changing project environment.	79	14.03%	77.62%
7	None of the top management knowledge requires prediction from project teams.	30	5.33%	82.95%
10	Project prediction is not borne in mind in the process of overhead cost planning and is also not realized as there is no budget for these purposes.	27	4.80%	87.74%
9	There is no time to perform project prediction under the weight of new projects and everyday worries.	25	4.44%	92.18%
5	Project teams are repeatedly composed of incompetent members who have neither the knowledge nor the experience to perform the prediction correctly, for which reason the prediction results do not correspond to the effort, time and resources expended.	22	3.91%	96.09%
6	Realized projects are usually evaluated as successful, even without prediction, so there is an impression that it is probably not necessary.	22	3.91%	100.00%

Graphic depiction of the Pareto analysis results is given in the Pareto diagram (see Figure 1). This is a combination of a bar and line graph, which includes the Lorenz curve, depicting the cumulative increase of the relative frequency of the cause in percent. The horizontal axis shows the number of cases of the cause of non-realization of projection prediction. The left vertical axis shows the number of respondents who ranked a given cause as significant. The right vertical axis shows the relative frequency in percent.

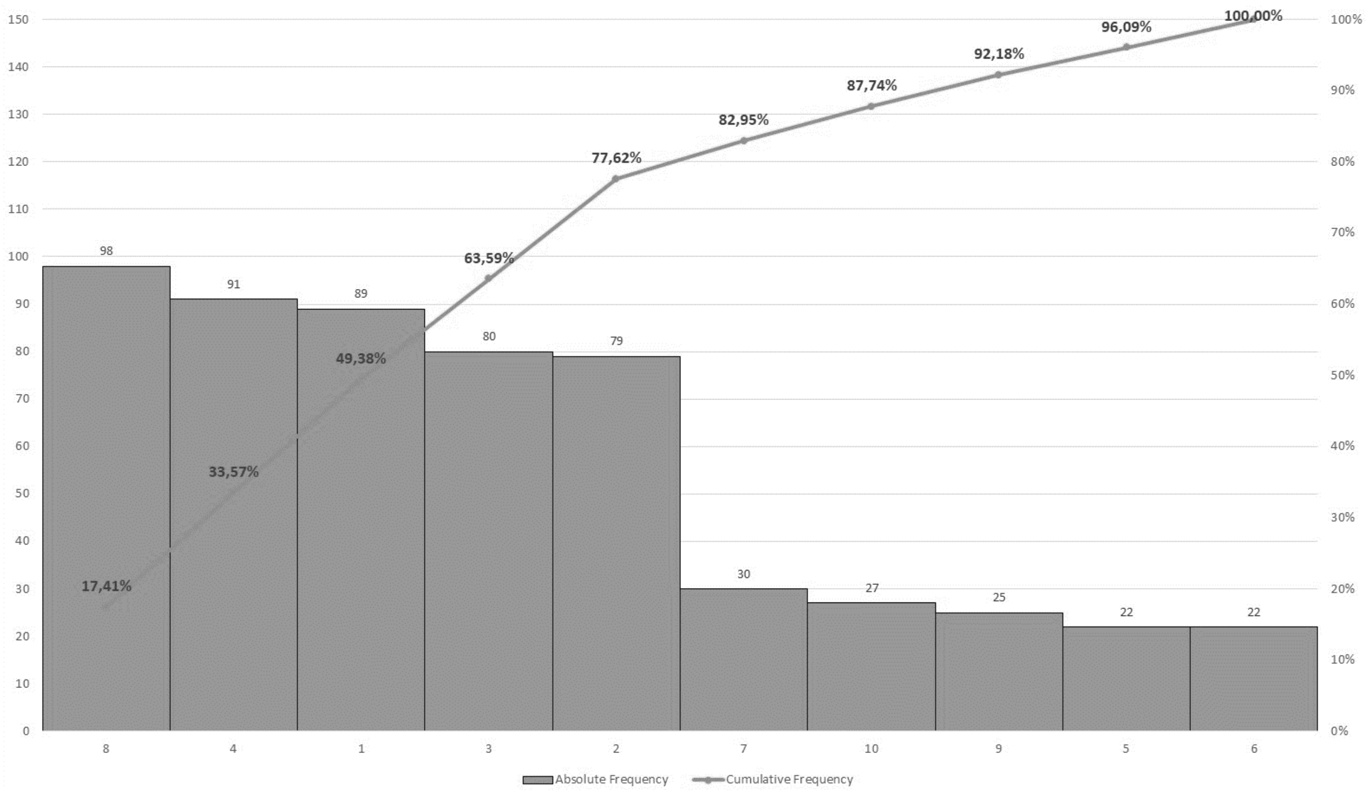

Figure 1. *Pareto chart of the causes of non-realization of project prediction.*

The Pareto diagram showed that the most significant causes of non-realization of project prediction are causes 8, 4, 1, 3 and 2. Approximately 80% of respondents agreed on these causes. They represent 50% of the total number of 10 causes. The ratio is not exactly 80/20, but what is important is that the majority results from only a small number of causes. These causes are evaluated as the most significant and will be considered in the proposal of a new framework of project prediction. The framework serves as a starting point for the development of a specific project prediction method. Causes 1, 2, 3 and 4 represent methodological weaknesses or errors in terms of project management methodology. The common denominator of this weaknesses is non-realization of the post-project phases, including the definition of their content. Cause 8 and partly cause 1 show that suitable methods for project prediction are completely lacking. If we manage to reduce these causes, then the project prediction problem will be significantly reduced.

4.2 Identification of the reasons why the current approaches to project prediction do not provide satisfactory results

The following reasons why the current approaches to project prediction do not provide satisfactory results have resulted from the research:

- The unfamiliarity and inexperience of members of project teams with the problems of prediction of further development of these projects.

- Failure to include project prediction among the knowledge competencies of project managers in materials such as PMBOK (PMI 2017) and IPMA Competence Baseline (Vukomanovic et al., 2016).
- Absence of knowledge that would have been acquired in post-project phases by system analysis of completed projects.
- Incorrect assumption of unchanging conditions during the course of the project.

4.3 Proposal of a new framework of project prediction

The newly designed framework of project prediction takes into account the identified causes of non-realization of project prediction and minimizes the weakness of current approaches. It is based on respecting the following two attributes:

[1] Changing conditions during the project lifecycle

The approaches of project prediction based on statistical principles (e.g. squares approximation, logistic function approximation (Field et al., 2012)) are not suitable for sophisticated project prediction. They are usually based merely on analysis of historical project data. The project prediction approach using statistical methods assumes the project (statistically monitored experiment) will continue under the same, i.e. unchanged, conditions in the future as it did in the past. However, this necessary condition is not met by the vast majority of projects. Conditions usually change significantly during the predicted period. In a VUCA world, the same implementation conditions as in the previous period cannot be ensured for future continuation of the project. Therefore, when predicting the future development of a project, we must have at our disposal a procedure in which we take into account past values and make a correction of future values that takes into account the probable influence of future changed conditions. This is exactly what Markov chains make possible (see attribute 2).

[2] Changes in the way of thinking in project prediction

These are represented by the application of the assumptions below:

- Past project progress up to the moment of prediction – we must analyse events in the past that have led to the current situation.
- Project status at the time of prediction – we must identify the immediate status of the project against the planned status at the moment of project prediction, using e.g. the EVM method (Earned Value Management) (Vanhoucke, 2014), the Percentage Method (Lee et al., 2017; Schwalbe, 2015), Milestones Trend Analysis (Lacko, 2012) or the SSD (Structure – Status – Deviation) Method (Leekwang & Favrel, 1988).
- The anticipated situation and the impact of external influences during the further progress of the project – the past and the present should lead the project team to the appropriate conclusions and to minimize the identified deviations from the plan so that the project proceeds according to plan.
- Interventions planned by the project team to achieve the target state – proactive project influence (e.g. employ more resources in the event of delays, increase financial funds for project implementation).

The principle of finite automata can fulfil the above assumptions (Lawson, 2004; Ustundag, 2017). It could be assumed that from the point of view of project status the project behaves as a non-deterministic finite automaton (Bartoska et al., 2015). Its sequence of states can be described using Markov chains (Doležal, 2010; Yun et al., 2019).

In project management, the state of the project is characterized by a set of values characterizing facts relating to the project schedule, the draw-down of project costs, the amount of available human and technical resources for the project, etc. When applying the theory of finite automata, the authors recommend using:

- a vector of selected defined values on project progress – e.g. status (sequence number, deviation in cost draw-down, deviation from schedule), or
- defined sets of own denominations that are used in a given company to characterize the status of a project (e.g. the project is running "very well", "well", "with difficulty", "poorly", "very poorly", "project is in crisis").

It is necessary to bear in mind that the possible accuracy of prediction is influenced by the length of the interval between the time at which we create the forecast and the moment for which the forecast is created. The longer the interval, the greater the probability of inaccuracy of the prediction. Another view of this issue is what is known as the cone of uncertainty that has to be taken into account (Naegeli & Laura, 2019).

Of course, if we find out the status of the project, we should proceed immediately to the creation of a prediction and not unnecessarily postpone the prediction, because the actual status of the project may change in the meantime.

A schematic model of the new framework of project prediction is presented in Figure 2. The dashed arrows represent dependencies between project prediction attributes. The solid arrows represent inputs into the project prediction model.

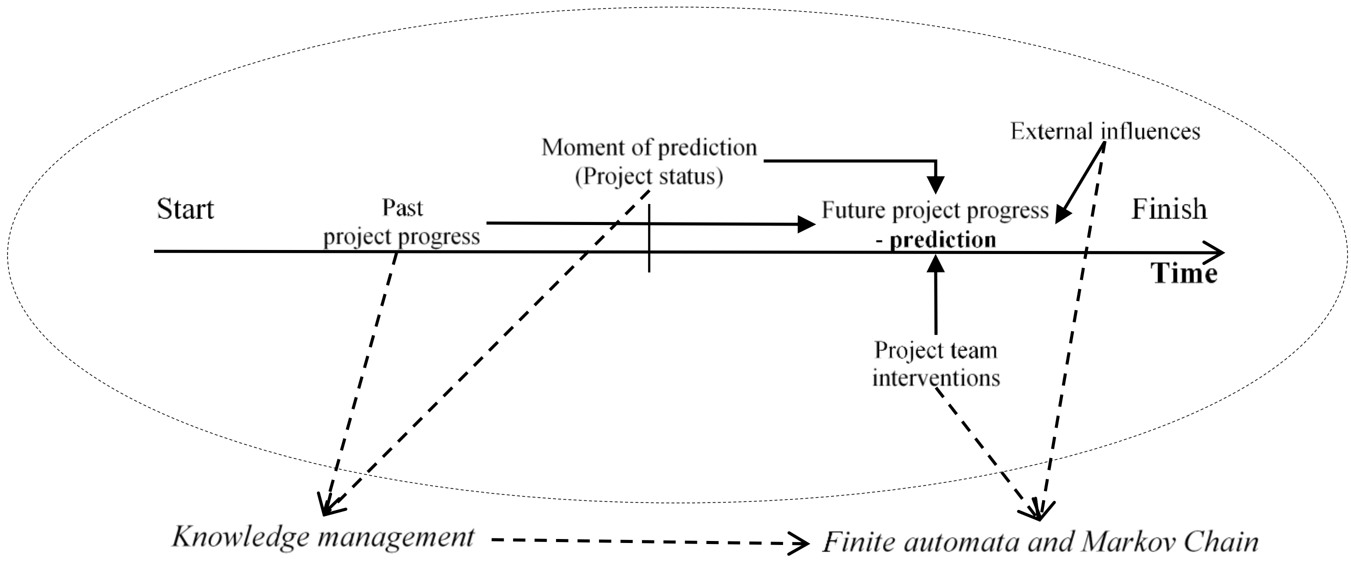

Figure 2. *Framework of project prediction – schematic model.*

Figure 2 contains the basic elements of a project prediction framework shown on a timeline. The element "Start" generally represents the beginning of the project, the element "Finish" represents the end of the project, and the element "Moment of Prediction" represents the moment at which a prediction is made for the required time interval. The element "Knowledge Management" serves as a platform for evaluating past project progress. The element "Finite Automata and Markov Chain" serves as a tool for creating a prediction taking into account the interventions of the project team (see the element "Project Team Interventions") and external influences such as market, political and technical influences (see the element "External Influences").

5 Discussion

The fact that the conclusions of inductive thought processes are always influenced by the subjective attitudes (experiences, knowledge) of the respondents can be characterized as a certain limitation of the research and therefore indicate its limited validity. Nevertheless, the results are highly valuable as they formulate a theoretical concept in the area of project prediction.

The response to research question 1: The findings reveal that the main causes of the non-realization of project prediction are as follows: there is no methodology which could be practically used; simplified approaches for project predictions are usually of low reliability and are therefore generally unusable; suitable input data and information is not available for project prediction.

The response to research question 2: The findings reveal that the main reasons why the current approaches to project prediction do not provide satisfactory results are, in particular, the absence of input data, information and knowledge that would have been acquired in the post-project phases by system analysis of completed projects and incorrect assumptions of unchanging conditions during the project lifecycle.

In order to improve the quality of project prediction, a new framework of project prediction has been designed which respects changing conditions during the lifecycle of the project and changes in the way of thinking in project prediction. Thanks to this assumption, the proposed framework provides more realistic project prediction that respects past project progress, project status at the time of prediction, the impact of external influences and project team interventions. This approach to project management makes it possible for project teams to make proactive adjustments to the project in real time.

The proposed project prediction framework does not mean that project teams should forget about common sense based on best practices, see the authors Halkjelsvik et al. (Halkjelsvik & Jørgensen, 2018). On the contrary, they should use this knowledge and experience within the new framework so that the prediction of projects is not merely an unqualified estimate or a confusing prophecy.

The benefits of the proposed framework of project prediction: systematicity (respecting the system approach and system dynamics (Šviráková, 2017)), modularity/adaptability (providing flexibility according to the user's needs and for the specific conditions at the company), and updating (improving the framework based on new factors and experiences).

The proposed framework of project prediction is particularly suitable for application in "well-structured projects" (e.g. development and production projects). These projects are, however, complicated according to the CYNEFIN framework (Mikkelsen, 2018; Shao et al., 2022), though a standardized methodical procedure is generally available. In contrast, it is recommended to apply agile (scrum) or iterative approaches in "poorly-structured projects" which are generally complex and in which the ratio between uncertainty (instability of the environment) and uncertainty of the assignment (what the result should be) is significant. The proposed framework of project prediction is not so suitable for these project types, because it is extremely complicated to fulfil its three assumptions.

A necessary prerequisite for sophisticated project prediction based on the proposed framework is the provision of high-quality input data, information and knowledge, for which reason project prediction cannot be performed without knowledge management (Nonaka, 2007; Senge, 2006; Shongwe, 2015; Swan et al., 2010). Knowing nothing and predicting the development of a project is nothing more than mere speculation on the state of the project or its prediction. One of the new processes already given in the PMBOK® Guide 6th Edition (Ng et al., 2020; Project Management Institute, 2017) is the process "Manage Project Knowledge", which is included as part of the Executing Process Group and Project Integration Management knowledge area.

The application of knowledge management in project management has been considered by many authors. Ginevičius et al. developed a knowledge management model in the construction projects industry. The proposed knowledge model comprehensively analyses the legal, economic, technical, organizational, technological, social, cultural, political, ethical and psychological factors that influence project planning and management and contribute to increased competitiveness (Ginevičius et al., 2011). Handzic and Durmic present a new conceptual model that combines the principles of knowledge management with project management. Their model points to the need for convergence knowledge management and other managerial disciplines such as project management, innovation management, risk management, etc., which is the current trend in knowledge management known as "the fourth generation" (Handzic & Durmic, 2014). Research by the authors Handzic and Bassi focuses on combining knowledge management and project management as a key approach to successful project planning and management. They present new theoretical approaches and clear empirical evidence of the value of integrating project management and knowledge management (Handzic & Bassi, 2017). Research by the authors Milosevic et al. analyses the impact of top management involvement and the knowledge-sharing process on project performance. The relationships were analysed on a sample of CEOs, directors and project managers at a selected international bank. Research confirms the fact that the human factor is one of the decisive factors in project success (Milosevic et al., 2019).

In order to identify the necessary knowledge to be used for sophisticated prediction of the future development of a project, the authors recommend the following methodological procedure, based in particular on analysis of the course of the project and the results of post-project analyses. The steps are as follows:

1. Development of project design documentation and its storage in digital form.
2. Evaluation of project status and preparation of reports on project progress and their storage in digital form.
3. Analysis of the completed project and storage of the results of analyses in digitized form.
4. Proposals for measures to be taken in other projects and their storage in digital form.
5. Identification of knowledge related to project management and prediction by data mining methods.
6. Representation and modelling of acquired knowledge, using logic diagrams, semantic networks, frames, etc., either in tabular form, acceptable to insiders, or in a digitized knowledge base (Khalil & Khalil, 2020; Sjodin, 2019).
7. Utilization of the described knowledge for project prediction by project managers directly or indirectly through a digitized knowledge base, e.g. in the form of an information (Kostalova et al., 2015) or expert system (Dávideková et al., 2020; Robinson, 1989) oriented towards project prediction according to the model described in this paper or in other ways, e.g. artificial neural networks, machine learning, a higher form of artificial intelligence, etc. (Kasabov, 2019).

The implementation of the proposed methodology into project practice and increasing its success influenced first and foremost by the application of the following conditions:

- Project managers must be directly involved in all seven steps.
- Steps 5 to 7 require the assistance of knowledge engineers. They should also implement an appropriate expert system based on a suitable algorithm in terms of project type.
- Project knowledge management must be implemented from the very beginning of the project.
- The methodological procedure described in the seven steps must be implemented systematically for each project.

If the necessary conditions given above are not respected or fulfilled, there is a high risk that the necessary knowledge related to project development prediction will not be identified at all (the worst case), that they will be identified partially, or they will "depart" with the project managers at the end of the project. If such an approach is taken, an increasing quality of project management in the area of projects, as well as improving the level of project prediction during their implementation, can scarcely be anticipated.

6 Conclusion

This paper presents research results in the area of project prediction. The main contributions of the paper are the ten causes of non-realization of project prediction identified and the reasons why the current approaches to project prediction do not provide satisfactory results. The second contribution is the proposal of the new framework of project prediction which respects three assumptions: changing conditions during the lifecycle of the project; change in the way of thinking in project prediction; a functioning system of knowledge management in projects. Thanks to this assumption, the proposed framework provides more realistic project prediction that respects past project progress, project status at the time of prediction, and the impact of external influences and project team interventions. This increases the success of projects and the effectivity of project management, because a project manager can identify where the project is going and whether any corrective proactive measures need to be implemented at each stage of the project. The issue of prediction is extremely important in current project management because the emerging agile methods of project management require a good command of project prediction for successful deployment.

Further research in the field of project prediction is planned along two lines: the first line should follow the inductive conclusions resulting from the defined research questions that formulated a theoretical concept in the area of project prediction. The next phase is the application of a deductive approach, i.e. the formulation of hypotheses and their subsequent statistical testing in order to confirm or refute the investigated phenomenon (e.g. project prediction vs project success). The second line imagines the creation of a mathematical model of project prediction in the context of finite automata and Markov chains, including a method, using a case study and including methodological support. A method will probably be proposed in three levels of complexity – basic complexity, moderate complexity, highest complexity – so the user can use it starting from basic principles to progressing to utilizing all the features. In addition to use in project milestone prediction, the method could also be modified for use in the opportunity study phase or feasibility study phase and in the event of a project crisis.

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